Low-Thrust Many-Revolution Trajectory Optimization

Completed Technology Project (2014 - 2018)

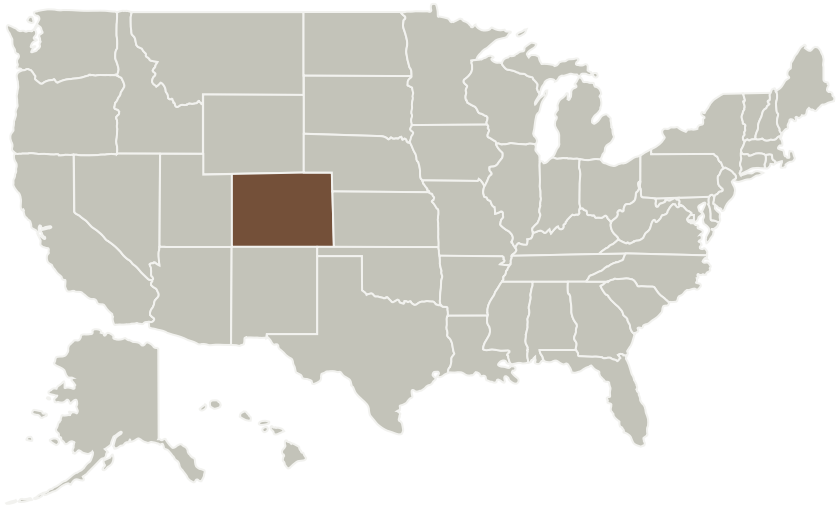
Project Introduction

This proposed research aims to solve the low-thrust many-revolution optimization problem. Optimal low-thrust spaceflight trajectories over hundreds of orbital revolutions offer increased mission life, heavier payloads, and cheaper costs. A solution to this optimization problem will improve such missions as interplanetary transfers and moon tours, and make new mission concepts possible. These new missions include asteroid rendezvous, satellite servicing, and active space debris removal. Modern low-thrust tools lack the fidelity to optimize trajectories that span hundreds of orbital revolutions. The central outcome of this research is a high-fidelity optimization technique for any multiobjective function, be it minimum fuel and maximum payload or any other combination of parameters. A tiered approach will be explored, that encompasses discretization, shape optimization, and optimal control. Outcomes outlined in Technology Area 5.4, Position, Navigation, and Timing, and Technology Area 02, In-Space Propulsion Technologies directly benefit from this research. This is inherently a navigation problem, and its solution will combine with low-thrust technology breakthroughs to achieve decreased transit times, increased payload mass, and reduced costs. This research will enable missions to new science and exploration targets.

Anticipated Benefits

This research will enable missions to new science and exploration targets.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
University of Colorado Boulder	Lead Organization	Academia	Boulder, Colorado

Primary U.S. Work Locations
Colorado

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Colorado Boulder

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Daniel Scheeres

Co-Investigator:

Jonathan D Aziz

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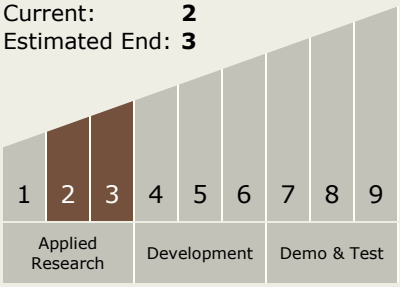
Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.2 Navigation Technologies
    - TX17.2.6 Rendezvous, Proximity Operations, and Capture Trajectory Design and Orbit Determination

Target Destinations

The Moon, Mars, Others Inside the Solar System